(Lummer and Pringsheim, Paschen, &c.), of the form of this function f is perhaps the most fundamental and interesting problem now outstanding in the general theory of the relation of radiation to temperature. The theoretical relations on which this expression is founded have been shown to be in agreement with fact; and it appears that the form $c_1 e^{-c_2/\lambda T}$ fairly represents $f(\lambda T)$ over a wide range of temperature.[1] These relations have been derived, as usual, from a dynamical discussion of the aggregate intensity of radiation belonging to the temperature; it may be shown that the same results, but nothing in addition, will be gained by applying the same principles to each constituent of range $\delta\lambda$ by itself, assigning to each its own temperature.

SCIENTIFIC SERIALS.

American Journal of Mathematics, vol. xxii., No. 4.—Asymptotic evaluation of certain totient sums, by D. N. Lehmer, is an attempt to account for what seems to be a remarkable law, first observed in particular cases in 1895. It is thus stated: Consider any set s of k linear forms, $an+b_i (i=1 \ . \ . \ . \ . \ k)$, all of which have the same modulus a, and where $[a, b_i]=1$, $[a, b]$ stands for the G.C. divisor of a and b. Consider, further, a function $\theta_s(x)$ such that $\theta_s(x)=1$ or 0, according as each of the prime divisors of x belongs to one of the forms of the set s or not. If, then, $\nu(x)$ denotes the number of distinct primes in x, we have

$$\operatorname*{Lim}_{N=\infty} \frac{\sum_{x=1}^{N} 2^{\nu(x)} \theta_s(x)}{N} = \text{constant}$$

The author's aim here is to prove this law where s is the set of linear forms belonging to a binary quadratic form. He also determines the constant in this case (pp. 293-335). Dr. E. H. Moore's paper concerning Klein's group of $(n+1)!$ ary collineations is a modification of a communication made to the American Mathematical Society, December 30, 1898. This short note is related to several papers by the author, amongst others with one communicated to the London Mathematical Society (December 1896, *see* vol. xxviii., p. 357). The closing paper (pp. 343-380), is one by H. E. Slaught, entitled "The Cross-ratio Group of 120 Quadratic Cremona Transformations of the Plane. Part i., Geometric representation." The group specially studied is a particular case, $n=5$ of the general cross-ratio group of order $n!$ Its consideration was undertaken as a dissertation at the University of Chicago at the suggestion and under the direction of Dr. Moore, and so is closely connected with the two papers referred to above. A few plates of figures are given at the end of the number, and also an obituary notice of Prof. T. Craig by Prof. S. Newcomb.

Symons's Monthly Meteorological Magazine, December.—Climatological table for the British Empire for the year 1899. This interesting summary of the climatological tables which have been published for a number of selected stations for the last quarter of a century shows that, generally speaking, the extreme values fall much to the same stations as usual. Adelaide records the maximum shade temperature, 113°·6 (in February). This temperature has only once been exceeded in these tables—viz. by 114°·2 in 1876. It had also the maximum temperature in the sun, 175°·7; this value is also unusual, the only higher reading being 180°, in 1882. It is also the driest station, the mean humidity being 59. The dampest station was Colombo, mean humidity 79; this station also records the highest mean temperature, 81°·9, and the greatest rainfall, 73·5 inches. The lowest temperature in the shade was −46°·5 at Winnipeg (in February); this station had also the greatest range in the year, 135°·9, the greatest mean daily range, 22°·3, and the lowest mean temperature, 34°·2. Mauritius was the most cloudy station—viz. 5·7; this extreme has several times been recorded at London, but in 1899 the cloud value was 5·6, only three out of the preceding forty years having been less cloudy.

SOCIETIES AND ACADEMIES.

LONDON

Royal Society, December 6.—"On the Bacterial Disease of the Turnip (*Brassica napus*)." By M. C. Potter, M.A., F.L.S., Professor of Botany in the University of Durham College of Science, Newcastle-upon-Tyne. Communicated by Sir M. Foster, Sec.R.S.

This paper gives the results of an investigation into the cause of a special disease of the turnip crop. The disease was discernible in plants still growing in the fields, some roots being found which were quite rotten, the decaying portion being white with a highly offensive and peculiar smell. The most careful microscopic search failed to detect any trace of hyphæ of the higher fungi in the decaying mass, but only a swarming mass of bacteria. The tissues were completely disorganised, the cells separating from each other along the middle lamella; the cell-walls were soft, swollen and faintly striated; the protoplasm, too, had lost its natural colour and become slightly brown and contracted. The disease could be readily communicated to sound, growing roots by merely making a slight incision and inoculating the root at the injured surface.

After a long series of cultures a bacterium was isolated, and pure cultures obtained grown from a single individual, which produced all the symptoms of "white rot" when sown upon sterile blocks of living turnip. This bacterium rapidly liquefies gelatine, it is a short, motile rod with a single polar flagellum, and, adopting Migula's classification, has been described under the name of *Pseudomonas destructaus*. When growing in a living plant tissue or in nutrient solutions, a cytase is secreted; this was isolated by the well-known method of precipitation by alcohol, and has been shown to cause the dissolution of the cells and the softening and swelling of the cell-walls of the host.

The appearance of the diseased tissue could not be entirely explained by the action of the cytase. It was found that the boiled, filtered juice of a turnip, which had become rotten through the influence of a pure culture of *P. destructaus*, had a powerful toxic effect upon the living plant cell. This toxin proved to be oxalic acid. A reaction probably takes place between the calcium pectate of the middle lamella and the oxalic acid produced by the bacteria, the calcium pectate neutralising the oxalic acid and thus permitting the continued growth of the bacteria.

The action of this bacterium upon living plant tissues is similar to that of some of the parasitic fungi; in both cases the invading organism produces oxalic acid, which acts as a toxin to the protoplasm and, decomposing the calcium pectate, furthers the dissolution of the cells; and also there is the secretion of a cytase, which has a destructive action upon the cell-wall and intercellular substance. The question of the parasitism of the bacteria thus stands in these respects on the same platform as that of the fungi, and a complete homology is established between them.

From numerous observations in the fields it would appear that *P. destructaus* is always introduced at a wounded surface, and through the agency of slugs and larvæ.

"On the Tempering of Iron Hardened by Overstrain." By James Muir, B.Sc., B.A., Trinity College, Cambridge, 1851 Exhibition Research Scholar, Glasgow University. Communicated by Prof. Ewing, F.R.S.

It is well known that iron hardened by overstrain—for example, by permanent stretching—may have its original properties restored again by annealing—that is, by heating it above a definite high temperature and allowing it to cool slowly. Experiments described in the paper, of which this is an abstract, show, however, that if iron hardened by overstrain be raised to any temperature above 300° C., it may be partially softened in a manner analogous to the ordinary tempering or "letting down" of steel which has been hardened by quenching from a red heat. This tempering from a condition of hardness induced by overstrain, unlike ordinary tempering, is applicable not only to steel, but also to wrought iron, and possibly to other materials which can be hardened by overstrain and softened by annealing.

The experiments described in the paper were all carried out on rods of iron and steel about $\frac{3}{8}$ths of an inch in diameter and 11 inches long, the elastic condition of the material being in all cases determined by means of tension tests, in which the hardness of the material was indicated by the position of the yield-point.

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[1] This might, however, be multiplied by $(T\lambda)^k$, and the experiments would hardly discriminate between the values zero (Wien), unity (Rayleigh), and one-half (Thiesen) for k, the latter value, which is entirely empirical, seems to fit best.

The method of overstraining and examining the materials employed was analogous to that described in a paper by the present author, "On the Recovery of Iron from Overstrain" (*Phil. Trans.*, A., vol. cxciii., 1899).

Experiments described in the paper, of which this is an abstract, showed that with mild steel which had been hardened by tensile overstrain until it could withstand a load of 50 tons per square inch without yielding, no appreciable softening was produced by heating the material to 300° C. A temperature of 350° C., however, lowered the yield-point to about 47 tons per square inch; 500°, 600° and 700° C. lowered the yield-point to about 40, 35 and 30 tons per square inch respectively.

It was further shown that the same temperature brought the yield-point to approximately the same stress, no matter what might be the original hardness of the specimen under test; and that the harder the material was made by tensile overstrain—that is, the higher the yield-point was raised by permanent stretching—the lower was the temperature which could be shown to produce a slight tempering effect.

The results ascribed above solely to temperature were found to be influenced to some extent by time. Thus it was found that by baking a hardened specimen for several hours at any temperature a greater effect was produced than by simply raising the specimen for a few minutes to that temperature. The effect of time was, however, small compared with that produced by increase of temperature.

All the tempering effects observed with steel were also obtained with Lowmoor iron. The hardening by overstrain and the tempering of soft Lowmoor iron only differed in detail from the analogous hardening and tempering of steel.

The iron and steel employed in this research were also examined when in various conditions of hardness by means of the microscope, and micro-photographs are reproduced in the paper. The ordinary methods of relief-polishing and of etching by dilute nitric acid were employed, and a new method of staining steel by rubbing with ordinary moistened cocoa was made use of and is described in the paper.

Geological Society, December 5.—J. J. H. Teall, F.R.S., President, in the chair.—On the Corallian rocks of St. Ives (Hunts) and Elsworth, by C. B. Wedd. (Communicated by permission of the Director-General of the Geological Survey.) Starting two and a half miles south-west of Elsworth, the author traces the Elsworth rock at intervals through Croxton, Yelling, Papworth Everard, &c., to Elsworth, and thence towards Fen Drayton and near Swavesey. The Oxford clay is found to the west of it, and the Ampthill clay to the east. Frequent fossil lists are given, and the character of the rock is described at the different exposures. Again, from Haughton Hall, west of St. Ives, the "St. Ives Rock" is traced through that town and towards Holywell.—The unconformity of the Upper (red) Coal Measures to the Middle (grey) Coal Measures of the Shropshire coalfields, and its bearing upon the extension of the latter under the Triassic rocks, by W. J. Clarke. The Upper Red Measures have a much greater extension in the Shropshire coalfields than the productive Measures below. In the Shrewsbury field they are the only Carboniferous rocks present, and rest on pre-Carboniferous rocks. When the sections of collieries at and near Madeley are plotted on the assumption that the base of the Upper Carboniferous rocks is horizontal, the Lower Measures are found to be bent into a syncline rising sharply to the north-north-west and more gently to the south-south-east. A second syncline, broader and deeper, extends from Stirchly towards Hadley, but the westerly rise is often hidden by the boundary-fault of the coalfield. This phenomenon is known locally as the "Symon Fault"; and instead of taking Scott's view that it represents a hollow denuded in the Lower Coal Measures, the author considers it due to folding before late Carboniferous times. A third little syncline occurs at the Inett and Caughley. Similar phenomena are exhibited in the Forest of Wyre coalfield, where a series of unproductive measures come in between the Lower and Upper Coal Measures.—Bajocian and contiguous deposits in the northern Cotteswolds: the main hill-mass, by S. S. Buckman. After giving comparative sections at Cleeve, Leckhampton Hill, and Birdlip, to show the disappearance of three horizons at the second locality and five more at the third, the author interprets the absence of the beds as due to "pene-contemporaneous erosion" brought about by the elevation of rocks, due to small earth-movements along a main south-west to north-east axis and subsidiary axes north-west to south-east.

Entomological Society, December 5.—Mr. G. H. Verrall, President, in the chair.—Mr. Jacoby exhibited specimens of *Hypocephalus armatus* from Bahia and *Chrysomela salisburiensis*, a new species, from Mashonaland.—Mr. Bower exhibited a specimen of *Spilosoma montanum*, an Asiatic species, bred from a larva found beginning of September 1897, feeding on birch on a moor near Paisley. The larva hibernated and spun a cocoon the following spring, not feeding after hibernation. Moth bred June 2, 1898. The moor on which the larva was found is used by the Glasgow Corporation for rubbish, the supposition being that an ovum or larva had been introduced with the refuse matter.—Mr. McLachlan exhibited a female of a dragon-fly of the genus *Tetracanthagyna* from North Borneo, similar to *T. vittata*, McLach., but with a very broad ante-apical fascia on the wings, and with some asymmetrical markings. He said there might be a question as to the specific identity or otherwise of the insect. There was also the question as to whether the insect described by Mr. C. O. Waterhouse as *Gynacantha plagiata* in the *Transactions* for 1878 was specifically the same. Mr. Waterhouse was of opinion that his insect was distinct.—Mr. R. Adkin exhibited two aberrant male specimens of *Argynnis aglaia*. In one of them the basal two-thirds of all the wings were almost completely covered with black, and broad black streaks crossed the remaining third of the wings to the outer margin, following the venation. In the other specimen the peculiarity consisted in the presence of a greenish-white blotch on each of the wings on the left side, similar in character to the pale blotches not infrequently observed in *A. paphia.* Both specimens were taken near Brighton in July last, where the species was unusually abundant.—Papers were communicated on observations on some species of *Orina*, a genus of viviparous and ovo-viviparous beetles, by Mr. G. C. Champion and Dr. T. A. Chapman, reported by Dr. T. A. Chapman; illustrations of the sixth male ventral segment in seventeen species of *Osmia* of the *Adunca* group, with a note on the synonymy of three species, and descriptions of five which appear to be new, by the Rev. F. D. Morice, M.A.; and an obituary notice of the late Dr. Otto Staudinger, by Mr. H. J. Elwes, F.R.S.

Linnean Society, December 6.—Mr. F. D. Godman, F.R.S., Vice-President, in the chair.—Dr. A. B. Rendle exhibited specimens, including leaves and fruit, of Grasswrack (*Zostera marina*, L.) recently found by Capt. H. P. Deasy near Yepal Ungar, in the Kwen Lun mountains, at an altitude of 16,500 feet. The plants were not growing in this remarkable locality, but were preserved in a bed 10 to 12 feet thick on top of, and interspersed with which were strata of blue clay. The broken leaves and sheaths of which the specimens consisted were dry and brittle, but showed no alteration, the internal structure being as perfect as in the fresh plant. As the country is geologically unknown, it is impossible to estimate the age of the deposit. It probably formed the bed of a salt-lake. There is one in the neighbourhood; and Capt. Deasy is of opinion that the whole district formed at one time a large salt-lake. The specimens were very dusty, but microscopic examination of the dust revealed nothing beyond particles of sand and a few small brown objects, apparently spores of some kind. Capt. Deasy states that he saw similar growths in a lake in the same district, but was unable to procure specimens. This occurrence of *Zostera marina* in the heart of the Asiatic continent, and at so great an elevation, is of special interest. The plant, so far as known, is purely marine, occurring plentifully on our own coasts and throughout Europe, on the Atlantic shores of North America, and in North-east Asia. It has not previously been recorded from an inland lake, though an allied species, *Zostera nana*, L., occurs in the Caspian. Whether its existence in the Kwen Lun range has any relation to the Tertiary marine deposits which connect the Mediterranean area with the Himalayas is matter for conjecture. There seems to be some evidence for the existence of *Zostera* in Upper Cretaceous and Tertiary times; at any rate several species have been described from fossils resembling the rhizome of the plant, found in Central European beds. Dr. Rendle also showed a specimen of another marine monocotyledonous plant, *Halophila stipulacea*, Asch., from Tuticorin in Southern India, sent by Mr. Edgar Thurston. This species is not included in the "Flora of British India," nor in Trimen's "Ceylon Flora," a plant found by Dr. Harvey at Trincomalee, and thus determined by Thwaites, being assigned to the commoner *H. ovata*, Gaud. *H. stipulacea* occurs in the Red Sea, the Mascarene Islands, and Rodriguez.—The Rev. John Gerard exhibited some abnormally large shells of the swan mussel, *Ano-*

donta cygnea, forwarded from Claughton, Garstang, Lancashire, by Mr. W. Fitzherbert Brockholes. The three largest of these measured 8·75 inches, 8 inches and 7·5 inches in width, these measurements being considerably in excess of those given in the text-books, and of the examples figured as *Mytilus cygneus* in *Trans.* Linn. Soc. vol. viii. pl. 3, p. 109, and as *Mytilus stagnalis* (from Kew Gardens) in Sowerby's "British Miscellany," vol. i. pl. xvi. p. 33. It was stated that amongst other specimens found in the pond at Claughton, when drained, there was one of nine inches, twenty-eight measuring from 8 to 9 inches, and about a hundred of 7 to 8 inches.—Mr. F. Chapman read a paper on some new foraminifera from Funafuti, on which some remarks were made by Mr. Sherborne.—Mr. H. Groves, on behalf of Mr. G. C. Druce, communicated a paper entitled, A revision of the British thrifts (*Statice* and *Armeria*), in which he attempted a rectification of the synonymy, and discussed the value of the pubescence on the ribs of the calyx as a distinguishing character.

Royal Meteorological Society, December 19.—Dr. C. Theodore Williams, President, in the chair.—Mr. H. Mellish read a paper on the seasonal rainfall of the British Isles, which he illustrated with a number of lantern slides. He discussed the rainfall returns from 210 stations for the twenty-five years 1866-90, and calculated the percentage of the mean annual rainfall for each season. In winter the largest percentages of rainfall are found, as a rule, at the wet stations, and the smallest at the dry ones. Spring is everywhere the driest quarter, and the percentages are very uniform over the country, rather larger in the east then in the west. In summer the highest percentages are found in the dry districts, and the lowest in the wet ones. As the spring is everywhere dry, so is the autumn everywhere wet, and there is little difference in the proportion of the annual total which falls in the different districts. As regards the relation between the amount of rain which falls in the wettest and driest month at any station, it seems to be generally the case that the range is larger for wet stations than for dry ones. In wet districts rather more than twice as much rain falls, on the average, in the wettest month as in the driest, and in dry districts rather less than twice.

Edinburgh.

Mathematical Society, December 14.—Mr. J. W. Butters, President, in the chair.—Dr. Third read a paper on triangles triply in perspective, and a paper on four circles touching a common circle, by Prof. Allardice, was communicated to the meeting by Mr. George Duthie.

Cape Town.

South African Philosophical Society, November 28.—M. L. Péringuey, President, in the chair.—The Secretary read a paper by Dr. R. Broom, of Pearston, on the leg and toe bones of *Ptychosiagum*. Dr. Broom described a tibia and fibula, together with the greater part of two toes and a couple of carpal bones, found near Colesberg in association with the skull of *Ptychosiagum Murrayi* and presented to the Eastern Province Naturalists' Society by Mr. Leslie, of Port Elizabeth. The structure of the leg and toes confirm the view, based on the portion of the nostrils, that Ptychosiagum was an aquatic form.—Dr. J. D. F. Gilchrist read a paper entitled "The History of the Local Names of Cape Fishes." The object of the paper was to clear up certain difficulties caused by the use of different names and review their historical origin and development from a philological point of view. A list of over 200 names was procured, many of which were synonyms. These were arranged alphabetically, the synonyms grouped together and followed by the scientific name where possible. Traces of East Indian, French and Portuguese elements were found in the nomenclature, the most prominent being, however, Dutch and English.

New South Wales.

Linnean Society, October 31.—Mr. Henry Deane, Vice-President, in the chair.—Tasmanian land planarians: descriptions of new species, &c., by Thos. Steel.—Contributions to a knowledge of the Australian flora, Part iii., by R. T. Baker. A number of species of phanerogams and fungi not previously known to occur in New South Wales are recorded, as well as additional localities for already recorded New South Wales species.—Studies in Australian entomology: No. x., description of a new tiger-beetle from Western Australia, by Thomas G. Sloane.—Description of a specimen of kerosene shale from Megalong Valley, N.S.W., by Prof. C. E. Bertrand, Lille. A detailed description of the microscopic and macroscopic characters of a kerosene shale from Megalong are given. The shale belongs to the same type as the shales from Mount Victoria and Blackheath containing the alga, *Reinschia australis*. It is noteworthy, however, for the excellent state of preservation of the remains of the minute fossil forms. Associated with the alga are pollen grains and spores. The author has calculated that there are 16,830 thalli of *Reinschia* in a cubic millimetre of the shale.—On the "clouding" of white wine, by R. Greig Smith. A variety of chablis becomes clouded and turbid soon after bottling, which renders the wine commercially useless. The cause has been traced to an acetic-acid-forming bacterium which grows only upon wine and yeast-derived fluids. By inoculation of the pure organism into sterile wine, the trouble was reproduced. The remedy consists in pasteurising the wine.—On some new species of Eucalyptus, by R. T. Baker.

St. Louis.

Academy of Science, December 3.—Mr. William H. Roever, of Washington University, read a paper on brilliant points and loci of brilliant points. The paper gave the analytical conditions which define the brilliant point of a surface, the brilliant point of a space curve, the brilliant point of a plane curve and the brilliant point in space of two dimensions, when the source of light is such that the incident rays are normal to a given surface and the recipient is such that the reflected rays are normal to another given surface. Formulæ were given for the important special case in which the source and recipient are points. The paper also contained a general method for finding the equation of the locus of the brilliant points of a moving or variable surface or curve, together with a number of applications. Such loci may often be perceived when an illuminated polished surface is rapidly moved, as when a wheel with a polished spoke is rapidly rotated. Another interesting example in loci of brilliant points is that of a circular saw which has been polished with emery in a lathe and thus received a great number of concentric circular scratches. The locus of the brilliant points of this family of scratches was shown in this paper to be a curve of the fourth degree. In the special case when the point source of light and the eye of the observer (the point recipient) are in a plane through the axis of the saw, the curve degenerates into a circle and two coincident straight lines.

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